Claims:

1. A method for generating qualitative and / or quantitative protein expression profiles of one or more populations of cells comprising:
    - generating lysates of one or more populations of cells, the lysates comprising a plurality of proteins expressed by the respective cell populations,
    - providing an essentially planar solid support,
    - depositing at discrete sites small quantities of the cell lysates as deposited samples, in diluted or undiluted form directly on said solid support or on an adhesion-promoting layer applied on said solid support, thereby creating one or more one- or two-dimensional arrays of discrete measurement areas on said solid support,
    - applying a number of binding reagents as specific binding partners for the proteins contained in cell lysates in discrete measurement areas and to be detected and, if adequate, one or more detection reagents on said one or more arrays of measurement areas, the binding reagents and the detection reagents being applied sequentially or in a single addition-step, after binding of the detection reagents to the binding reagents, to the one or more arrays of discrete measurement areas, and
    - measuring and recording optical signals emanating from said one or more arrays of discrete measurement areas in a locally resolved manner,

    wherein said essentially planar solid support is non-porous and an optionally applied adhesion-promoting layer has a thickness of less than 1 μm.

2. A method for generating qualitative and / or quantitative differential protein expression profiles of two or more populations of cells comprising:
    - generating a first lysate of a population of cells, the lysate comprising a plurality of proteins expressed by the respective cell population,
    - generating second or more lysates of further populations of cells, the lysates comprising pluralities of proteins expressed by the respective cell population,
    - providing an essentially planar solid support,
    - depositing at discrete sites small quantities of the cell lysates as deposited samples, in diluted or undiluted form directly on said solid support or on an adhesion-promoting layer applied on said solid support, thereby creating one or

more one- or two-dimensional arrays of discrete measurement areas on said solid support,

- applying a number of binding reagents as specific binding partners for the proteins contained in cell lysates in discrete measurement areas and to be detected and, if adequate, one or more detection reagents on said one or more arrays of measurement areas, the binding reagents and the detection reagents being applied sequentially or in a single addition-step, after binding of the detection reagents to the binding reagents, to the one or more arrays of discrete measurement areas, and
- measuring and recording a first group of optical signals emanating from the measurement areas created by deposition of small quantities of the first lysate, in diluted or undiluted form, in a locally resolved manner,
- measuring and recording second or more groups of optical signals emanating from the measurement areas created by deposition of small quantities of the second or more lysates, in diluted or undiluted form, in a locally resolved manner,
- comparing the measured values of the first group of optical signals with the values of the second or more groups of optical signals,

wherein said essentially planar solid support is non-porous and an optionally applied adhesion-promoting layer has a thickness of less than 1 μm.

3. A method according to any of claims 1 – 2, wherein different binding reagents as specific binding partners for different proteins are applied on different arrays for each different protein to be detected.

4. A method according to any of claims 1 – 2, wherein different proteins are detected in a common array by applying different distinguishable detection reagents on said array, the number of different proteins to be detected corresponding to the number of different distinguishable labels applied.

5. A method according to any of claims 1 – 2, wherein a plurality of different proteins is detected in multiple arrays of measurement areas by applying different binding reagents as specific binding partners for different proteins on different arrays for the

detection of different proteins and / or different distinguishable detection reagents on the arrays of measurement areas.

6. A method according to any of claims 1 – 5, wherein different lysates are generated from unrelated cell populations.

7. A method according to any of claims 1 – 5, wherein different lysates are generated from different cell sub-populations that have been obtained from a common cell population.

8. A method according to claim 7, wherein different lysates are generated from different cell sub-populations that have been obtained from a common cell population at different points in time.

9. A method according to any of claims 7 – 8, wherein different lysates are generated from different cell sub-populations that have been obtained from a common cell population and then treated or stimulated with different reagents and / or exposed to different cultivation conditions.

10. A method according to any of claims 1 – 9, wherein different lysates are generated from diseased and healthy cell populations.

11. A method according to any of claims 1 – 10, wherein the healthy or diseased and / or treated or untreated and / or stimulated cell populations from which the lysates have been generated, have been derived from the group comprising prokaryotic cells, such as bacteria, and eukaryotic cells, such as human, animal, or plant cells, in particular human or animal tissue, such as organ, skin, hair or bone tissue, or plant tissue, and comprising cell-containing body fluids or their constituents, such as blood, serum or plasm, synovial liquids, lacrimal fluid, urine, saliva, tissue fluid, lymph.

12. A method according to any of claims 1 – 11, wherein the lysates, in diluted or undiluted form, that are deposited at discrete sites on the solid support or on an adhesion-promoting layer on said solid support have the same relative molecular

compositions of the proteins to be detected therein as the cell populations from which the lysates have been generated.

13. A method according to any of claims 1 – 11, wherein the lysates contain added known concentrations of compounds (as standards) similar to the analytes to be determined as additives, which may, for example, be used for calibration purposes.

14. A method according to any of claims 1 – 13, wherein the material deposited in a single measurement area corresponds to the protein content of less than 1000 cells.

15. A method according to any of claims 1 – 14, wherein multiple arrays of measurement areas are arranged in an identical geometry of the deposition sites of the diluted or undiluted cell lysates, a similar position with respect to rows and column of a measurement area in two different arrays corresponding to deposited amounts from the same (diluted or undiluted) cell lysate deposited therein.

16. A method according to any of claims 1 – 15, wherein an adhesion-promoting layer applied on the solid support has a thickness of less than 200 nm, preferably of less than 20 nm.

17. A method according to claim 16, wherein said adhesion-promoting layer comprises compounds of the group of silanes, functionalized silanes, epoxides, functionalized, charged or polar polymers and "self-organized passive or functionalized mono- or multi-layers", thiols, alkyl phosphates and alkyl phosphonates, multi-functional block copolymers, such as poly(L)lysin/polyethylene glycols.

18. A method according to any of claims 16 - 17, wherein the samples are deposited laterally selectively in discrete measurement areas, directly on the solid support or on an adhesion-promoting layer deposited thereon, by means of a method selected from the group of methods comprising ink jet spotting, mechanical spotting by pen, pin or capillary, "micro contact printing", fluidic contacting of the measurement areas with the samples through their supply in parallel or crossed micro channels, with application of pressure differences or electrical or electromagnetic potentials, and photochemical or photolithographic immobilization methods.

19. A method according to any of claims 1 - 18, wherein regions between the discrete measurement areas are "passivated" in order to minimize nonspecific binding of binding and / or detection reagents, i.e. that compounds which are "chemically neutral" (i.e. nonbinding) towards the analytes (i.e. proteins) and the other contents of the deposited samples and the binding reagents and, if adequate, towards the detection reagents are deposited between the laterally separated measurement areas.

20. A method according to any of claims 1 - 19, wherein the proteins which are to be detected and are contained in the diluted or undiluted lysates deposited in discrete measurement areas are compounds of the group of proteins comprising cytosolic, nuclear and membrane proteins, secreted proteins in body fluids (cytosolic and membrane-bound cell proteins, especially proteins involved in the processes of signal transduction in cells, such as kinases), post-translationally modified proteins like phosphorylated, glycosylated, methylated, and acetylated forms of proteins, in particular proteins over- and or under-expressed under treatment, said group comprising antibodies, artificially overexpressed proteins, artificially overexpressed modified proteins like functionalized proteins with additional binding sites ("tag proteins", such as "histidine tag proteins"), and fluorescent proteins ("green fluorescent proteins", GFP and the like).

21. A method according to any of claims 1 – 20, wherein the proteins which are to be detected and are contained in the diluted or undiluted lysates deposited in discrete measurement areas are distinguished in the step of binding added specific binding reagents and, if adequate, detection reagents, added sequentially or in a single addition step, after binding of the detection reagents to the binding reagents, according their occurrence in phosphorylated and / or nonphosphorylated form and / or glycosylated and / or nonglycosylated form and / or methylated and / or non-methylated form and / or acetylated and / or non-acetylated form contained in the diluted or undiluted deposited lysates to be analyzed.

22. A method according to any of claims 1 – 20, wherein the proteins which are to be detected and are contained in the diluted or undiluted lysates deposited in discrete measurement areas are not distinguished in the step of binding added specific binding

reagents and, if adequate, detection reagents, added sequentially or in a single addition step, after binding of the detection reagents to the binding reagents, between their occurrence in phosphorylated or nonphosphorylated form and / or glycosylated or nonglycosylated form and / or methylated or non-methylated form and / or acetylated or non-acetylated form contained in the diluted or undiluted deposited lysates to be analyzed.

23. A method according to any of claims 1 – 22, wherein the material of the essentially planar solid support being in physical contact with the generated measurement areas either directly or mediated by an adhesion promoting layer is essentially optically transparent.

24. A method according to any of claims 16 – 23, wherein the material of an adhesion layer applied on the solid support is essentially optically transparent.

25. A method according to any of claims 1 – 24, wherein the material of the essentially optically transparent solid support comprises a material from the group comprising moldable, sprayable or millable plastics, metals, metal oxides, silicates, such as glass, quartz or ceramics.

26. A method according to any of claims 1 – 25, wherein probing light from one or more polychromatic or monochromatic light sources is directed towards one or more measurement areas in one or more arrays of measurement areas and optical signals emanating from said one or more arrays of measurement areas and / or changes in these optical signals are measured and recorded.

27. A method according to claim 26, wherein the probing light is delivered in an epi-illumination configuration.

28. A method according to claim 26, wherein the probing light is delivered in a trans-illumination configuration.

29. A method according to any of claims 1 – 28, wherein the detection of one or more proteins in discrete measurement areas is based on the detection of the intensities or changes in the intensities of one or more luminescences.

30. A method according to any of claims 1 – 28, wherein the detection of one or more proteins in discrete measurement areas is based on the detection of changes in the refractive index on said measurement areas or within a distance of less than 1 μm from these measurement areas.

31. A method according to claim 30, wherein the detection of changes in the refractive index on said measurement areas or within a distance of less than 1 μm from these measurement areas is based on detection of changes in the pattern of interferences of light emanating from the planar solid support in the regions of the measurement areas generated on the solid support with light emanating from planes of interfaces to materials of different refractive index, caused by changes of the phase differences between the light emanating from said interfaces and the light emanating from the regions of the measurement areas due to binding or desorption or displacement of applied specific binding partners, and wherein the interference light emanating from the different regions is measured in a locally and, if adequate, spectrally resolved manner.

32. A method according to any of claims 1 – 30, wherein the solid support is provided with a thin metal layer, preferably of silver or gold and preferably with a thickness between 20 nm and 200 nm, which is directly or mediated by an adhesion-promoting layer in contact with the measurement areas, and the detection of changes in the refractive index on said measurement areas or within a distance of less than 1 μm from these measurement areas is based on detection of changes in the conditions for generating a surface plasmon resonance in said metal layer.

33. A method according to any of claims 1 - 32, wherein the solid support comprises a continuous optical waveguide or an optical waveguide divided into individual waveguiding areas.

34. A method according to claim 33, wherein the optical waveguide is an optical film waveguide with a first essentially optically transparent layer (a) facing the surface carrying the discrete measurement areas on a second essentially optically transparent layer (b) with a refractive index lower than that of layer (a).

35. A method according to claim 34, wherein, for the in-coupling of probing light into the optically transparent layer (a), this layer is in optical contact with one or more optical in-coupling elements from the group comprising prism couplers, evanescent couplers with combined optical waveguides with overlapping evanescent fields, butt-end couplers with focusing lenses, preferably cylinder lenses, arranged in front of one face of the waveguiding layer, and grating couplers.

36. A method according to claim 35, wherein the probing light is in-coupled into the optically transparent layer (a) using one or more grating structures (c) which are featured in the optically transparent layer (a).

37. A method according to any of claims 34 - 36, wherein light guided in the optically transparent layer (a) is out-coupled using one or more grating structures (c') which are featured in the optically transparent layer (a).

38. A method according to any of claims 34 - 37, wherein the detection of proteins in the measurement areas takes place via a grating structure formed in the layer (a) of an optical film waveguide based on changes in the resonance conditions for the in-coupling of probing light into layer (a) of a solid support formed as film waveguide or for out-coupling of light guided in layer (a), these changes resulting from binding of binding reagents and / or further detection reagents to proteins contained in the measurement areas.

39. A method according to any of claims 34 - 37, wherein said optical waveguide is designed as an optical film waveguide with a first optically transparent layer (a) on a second optically transparent layer (b) with lower refractive index than layer (a), wherein probing light is further in-coupled into the optically transparent layer (a) with the aid of one or more grating structures, which are featured in the optically transparent layer (a), and delivered as a guided wave to measurement areas (d) located

thereon, and wherein the luminescence of molecules capable of luminescence, generated in the evanescent field of said guided wave, is further determined using one or more detectors, and the relative amount of proteins contained in the measurement areas is determined from the intensity of these luminescence signals.

40. A method according to claim 39, wherein luminescences are generated upon excitation of detection reagents associated with binding reagents that have specifically bound to proteins to be detected in the measurement areas, and wherein the detection reagents comprise luminescent dyes or luminescent nanoparticles used as luminescence labels, which can be excited and emit at wavelengths between 300 nm and 1100 nm.

41. A method according to claim 40, wherein different distinguishable detection reagents feature different emission wavelengths and / or different emission lifetimes.

42. A method according to any of claims 1 – 41, wherein the probing light is delivered in pulses with a duration between 1 fs and 10 minutes and the emission light from the measurement areas is measured in a time-resolved manner.

43. An analytical platform for optical signal read-out and for generating qualitative and / or quantitative protein expression profiles of one or more populations of cells comprising:

- an essentially planar solid support,
- one or more one- or two-dimensional arrays of discrete measurement areas on said solid support, said arrays being generated by deposition of small quantities of cell lysates, in diluted or undiluted form, at discrete sites directly on said solid support or on an adhesion-promoting layer applied on the solid support before, the cell lysates originating from one or more populations of cells and containing a plurality of proteins expressed by these cell populations,

wherein said essentially planar solid support is non-porous and an optionally applied adhesion-promoting layer has a thickness of less than 1 μm.

44. An analytical platform for optical signal read-out and for generating qualitative and / or quantitative differential protein expression profiles of one or more populations of cells comprising:

- an essentially planar solid support,
- one or more one- or two-dimensional arrays of discrete measurement areas on said solid support, said arrays being generated by deposition of small quantities of two or more cell lysates, in diluted or undiluted form, at discrete sites directly on said solid support or on an adhesion-promoting layer applied on the solid support before, the cell lysates originating from two or more populations of cells and containing a plurality of proteins expressed by these cell populations,

wherein said essentially planar solid support is non-porous and an optionally applied adhesion-promoting layer has a thickness of less than 1 µm.

45. An analytical platform according to any of claims 43 – 44, wherein different deposited lysates have been generated from unrelated cell populations.

46. An analytical platform according to any of claims 43 – 44, wherein different deposited lysates have been generated from different cell sub-populations that have been obtained from a common cell population.

47. An analytical platform according to claim 46, wherein different deposited lysates have been generated from different cell sub-populations that have been obtained from a common cell population at different points in time.

48. An analytical platform according to any of claims 46 – 47, wherein different deposited lysates have been generated from different cell sub-populations that have been obtained from a common cell population and then treated or stimulated with different reagents and / or exposed to different cultivation conditions.

49. An analytical platform according to any of claims 43 – 48, wherein different deposited lysates have been generated from diseased and healthy cell populations.

50. An analytical platform according to any of claims 43 – 49, wherein the healthy or diseased and / or treated or untreated and / or stimulated cell populations from which the deposited lysates have been generated, have been derived from the group comprising prokaryotic cells, such as bacteria, and eukaryotic cells, such as human, animal, or plant cells, in particular human or animal tissue, such as organ, skin, hair or

bone tissue, or plant tissue, and comprising cell-containing body fluids or their constituents, such as blood, serum or plasm, synovial liquids, lacrimal fluid, urine, saliva, tissue fluid, lymph.

51. An analytical platform according to any of claims 43 – 50, wherein the lysates, in diluted or undiluted form, that are deposited at discrete sites on the solid support or on an adhesion-promoting layer on said solid support have the same relative molecular compositions of the proteins to be detected therein as the cell populations from which the lysates have been generated.

52. An analytical platform according to any of claims 43 – 50, wherein the deposited lysates have been subjected to no further sample treatment steps than filtration and / or fractionation and / or dilution.

53. An analytical platform according to any of claims 43 – 52, wherein the material deposited in a single measurement area corresponds to the protein content of less than 1000 cells.

54. An analytical platform according to any of claims 43 – 53, wherein multiple arrays of measurement areas are arranged in an identical geometry of the deposition sites of the diluted or undiluted cell lysates, a similar position with respect to rows and column of a measurement area in two different arrays corresponding to deposited amounts from the same (diluted or undiluted) cell lysate deposited therein.

55. An analytical platform according to any of claims 43 – 54, wherein an adhesion-promoting layer applied on the solid support has a thickness of less than 200 nm, preferably of less than 20 nm.

56. An anlytical platform according to claim 55, wherein said adhesion-promoting layer comprises compounds of the group of silanes, functionalized silanes, epoxides, functionalized, charged or polar polymers and "self-organized passive or functionalized mono- or multi-layers", thiols, alkyl phosphates and alkyl phosphonates, multi-functional block copolymers, such as poly(L)lysin/polyethylene glycols.

57. An analytical platform according to any of claims 43 - 56, wherein regions between the discrete measurement areas are “passivated” in order to minimize nonspecific binding of tracer compounds, i.e. that compounds which are “chemically neutral” (i.e. nonbinding) towards the binding reagents and, if adequate, towards the detection reagents are deposited between the laterally separated measurement areas.

58. An anlytical platform according to any of claims 43 - 57, wherein the proteins which are to be detected and are contained in the diluted or undiluted lysates deposited in discrete measurement areas are compounds of the group of proteins comprising cytosolic, nuclear and membrane proteins, secreted proteins in body fluids (cytosolic and membrane-bound cell proteins, especially proteins involved in the processes of signal transduction in cells, such as kinases), post-translationally modified proteins like phosphorylated, glycosylated, methylated, and acetylated forms of proteins, in particular proteins over- and or under-expressed under treatment, said group comprising antibodies, artificially overexpressed proteins, artificially overexpressed modified proteins like functionalized proteins with additional binding sites (“tag proteins”, such as “histidine tag proteins”), and fluorescent proteins (“green fluorescent proteins”, GFP and the like).

59. An analytical platform according to any of claims 43 – 58, wherein the material of the essentially planar solid support being in physical contact with the generated measurement areas either directly or mediated by an adhesion promoting layer is essentially optically transparent.

60. An analytical platform according to any of claims 43 – 59, wherein the material of an adhesion layer applied on the solid support is essentially optically transparent.

61. An anlytical platform according to any of claims 43 - 60, wherein the material of the essentially optically transparent solid support comprises a material from the group comprising moldable, sprayable or millable plastics, metals, metal oxides, silicates, such as glass, quartz or ceramics.

62. An analytical platform according to any of claims 43 – 61, wherein the solid support is provided with a thin metal layer, preferably of silver or gold and preferably with a thickness between 20 nm and 200 nm, which is directly or mediated by an adhesion-promoting layer in contact with the measurement areas, the platform being operable for generating a surface plasmon resonance in said metal layer.

63. An analytical platform according to any of claims 43 - 62, wherein the solid support comprises a continuous optical waveguide or an optical waveguide divided into individual waveguiding areas.

64. An analytical platform according to claim 63, wherein the optical waveguide is an optical film waveguide with a first essentially optically transparent layer (a) facing the surface carrying the discrete measurement areas on a second essentially optically transparent layer (b) with a refractive index lower than that of layer (a).

65. An analytical platform according to claim 64, wherein, for the in-coupling of probing light into the optically transparent layer (a), this layer is in optical contact with one or more optical in-coupling elements from the group comprising prism couplers, evanescent couplers with combined optical waveguides with overlapping evanescent fields, butt-end couplers with focusing lenses, preferably cylinder lenses, arranged in front of one face of the waveguiding layer, and grating couplers.

66. An analytical platform according to claim 65, wherein one or more grating structures (c) are featured in the optically transparent layer (a) for allowing in-coupling of probing light into the optically transparent layer (a).

67. An analytical platform according to any of claims 64 - 66, wherein one or more grating structures (c’) are featured in the optically transparent layer (a), which allow out-coupling of light guided in the optically transparent layer (a).

68. An analytical platform according to any of claims 64 - 67, wherein said optical waveguide is designed as an optical film waveguide with a first optically transparent layer (a) on a second optically transparent layer (b) with lower refractive index than layer (a), and wherein the analytical platform is operable of in-coupling probing light

into the optically transparent layer (a) with the aid of one or more grating structures, which are featured in the optically transparent layer (a), delivering said probing light as a guided wave to measurement areas (d), and exciting luminescence of molecules capable of luminescence in the evanescent field of said guided wave.

69. The use of a method according to any of claims 1 – 42 and / or of an analytical platform according to any of claims 43 - 68 for quantitative and / or qualitative analyses for the determination of proteins and their modified forms in screening methods in pharmaceutical research, combinatorial chemistry, clinical and pre-clinical development, for real-time binding studies and the determination of kinetic parameters in affinity screening and in research, especially for the determination of proteomic differences in the proteome, for the measurement of protein-DNA interactions, for the determination of control mechanisms for the protein (bio)synthesis, for the screening of biological and chemical marker compounds, for patient stratification in pharmaceutical product development and for the therapeutic drug selection.